Engaging children in science learning

Lessons from Germany, the Netherlands, Scotland and England

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Churchill Fellow 2019

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Fig 1: Haus der wissenschaft (house of science) Bremen, Germany

1. INTRODUCTION

The Winston Churchill Memorial Trust Travelling Fellowship

The New Zealand Government established the Winston Churchill Memorial Trust Board in 1965, in memory of Sir Winston Churchill. Fellowships awarded by the Trust each year enable New Zealanders to travel overseas to undertake research in their area of expertise. The trust helps people to travel overseas to learn from others and study topics that will advance their occupation, trade, industry, profession or community and benefit New Zealand. I was awarded a Fellowship for travel in 2019 and spent 31 days in Europe.

New Zealand Association of Science Educators (NZASE)

I also received a grant from NZASE which allowed me to attend the Primary Science Educators Conference (PSEC) in Edinburgh. This is a three-yearly international conference run by the Primary Science Teaching Trust (PSTT).

Background

Science is a major influence on many aspects of children's daily lives. Science is not directly funded in New Zealand schools which means many of our schools are not well equipped to provide resources for children to learn basic science principles.

Not only does this limit their choices when leaving school but an understanding of science is necessary if they are to participate actively, confidently and usefully in the world they live in and the one they will create.

Schools in New Zealand have considerable authority and latitude in how the national curriculum is interpreted and implemented, and have scope to develop initiatives, programmes, and approaches suited to the particular interests and needs of their students and any special features of their local environment. Moreover, each school is challenged to identify and articulate their core principles, values, pedagogy, and approaches to teaching and learning, while ensuring that they are consistent with the national curriculum document.

Most students have their first specialist teachers for science beginning in year nine, the first year of secondary education. However, a few students have specialist teachers for these subjects in years seven and eight. Where there are teacher shortages, students may not have a science specialist until year 11, the first year of external examinations.

New Zealand school science statistics

The most recent Trends in International Mathematics and Science Study (TIMSS 2015 [(a)]) ranks New Zealand 33rd out of 47 countries in year five science, and 16th out of 39 in year nine science, well behind England, Germany and the Netherlands. New Zealand's TIMSS results in 2015 were an improvement on the 2011 results.

The Programme for International Student Assessment (PISA[(b)]) tests 15-year-old students from 68 OECD countries. The most recent results show New Zealand on a par with Germany, the Netherlands and the United Kingdom. New Zealand's PISA results show a downwards trend.

Locally, the National Monitoring Study of Student Achievement (NMSSA[c]) report released in December 2018 showed 80% of year eight students in New Zealand are not achieving at curriculum expectation for science, making this subject the worst taught in our primary schools. This is exacerbated by many primary and intermediate teachers lacking the confidence and resources to teach science.

On average, year five students are exposed to just one hour of science instruction per week (TIMSS 2015 [a]). This is limiting their career choices in the future and their ability to participate as active, confident and useful citizens.

Fig 2: National STEM Learning Centre, York, England

2. AIMS OF THE FELLOWSHIP

My application to the Winston Churchill Memorial Trust Travelling Fellowship centred on exploring ways countries like New Zealand engage primary school children in their science learning. I chose to travel to Germany, the Netherlands, Scotland and England because these countries are in close proximity, have better TIMSS results than New Zealand and in Scotland's case have a comparable population size.

Short term aims

The short term aims of the Fellowship were to gain an understanding of formal and informal science education of primary aged children, with a focus on student engagement, teacher support and funding mechanisms.

In order to gather data, I met with a variety of people involved in science education leadership roles, visited schools, science centres and museums and attended a primary science teacher conference.

Long term aim

In my role as CEO of the House of Science I am in regular contact with a variety of people in the Ministry of Education, the Prime Minister's Chief Science Advisor's office, the Ministry of Business, Innovation and Employment and the New Zealand Association of Science Educators. I aim to share my findings from this trip in written form by way of this report and personally by invitation to conferences and private meetings.

The purpose of my Fellowship is to collaborate with people in key roles in primary science education to see how together we can enhance student engagement of science learning for New Zealand children aged five to 12 years. A higher level of engagement in science activities means children will be more likely to participate actively, confidently and usefully in the world they live in and the one they will create.

Engagement in primary science will also increase the likelihood of students choosing a science career pathway post formal schooling. This aligns with the Government's objective to encourage and support all New Zealanders to engage with science and technology.

Fig 3: Children at NEMO in Amsterdam, The Netherlands

3. ITINERARY

Bremen, Germany (May 22-26)

The University of Bremen has strong links to my hometown of Tauranga through the House of Science (Haus der wissenschaft) and the MARUM institute of marine science.

I met the Haus der wissenschaft founder and director and the MARUM institute director and school laboratory staff. I also visited two science centres: the Universum and the Klimahaus.

The Hague, Delft, Eindhoven and Amsterdam, the Netherlands (May 27-June 3)

I visited five science centres in the Netherlands: Corpus, Museon, Science Centre Delft, Ontdekfabriek and NEMO and met with several educational leaders in these organisations. In Delft I also visited a Dutch school that teaches the international primary curriculum (IPC).

Edinburgh, Scotland (June 4-9)

This was the venue of the Primary Science Education Conference. I also met with the CEO of the Scottish Schools Education Research Centre (SSERC) who focus solely on Science professional development. Edinburgh is also home to the national museum of Scotland.

York, England (June 10-12)

The university of York hosts the national centre for STEM (science, technology, engineering and maths) learning. I met with their primary science team leader, as well as the Salters' professor of science education and the director of the Centre for Industry Education Collaboration which is also based at the University of York.

London and Hatfield, England (June 13-19)

In London I met with the education programme manager at the Wellcome Trust, the CEO of the PSTT and the director of education at the British Science Association (BSA). I also visited the Wellcome collection and the science museum of London. In Hatfield, at the University of Hertfordshire, I met with the director of the Primary Science Quality Mark (PSQM) programme.

4. PERSONS OF INTEREST

Alistair MacGregor, CEO, SSERC

SSERC offers teaching and learning support for primary and secondary STEM educators through health and safety advice and teacher professional development programmes.

Alistair manages a team of 38 full time staff. SSERC receives significant government funding to enable their resources and programmes to be free for schools. The Scottish Government has a strong focus on supporting STEM education as part of their 'Curriculum for Excellence' [(d)].

Tanya Shields, Primary science team leader, STEM learning centre

The STEM learning centre is an impressive facility that houses over 100 staff who deliver residential teacher professional development as well as numerous online courses to teachers across the UK. The primary science department that Tanya leads delivers approximately 2,500 days of professional learning and development (PLD) per year.

The centre is funded by the government's Department for Education, the Wellcome Trust and several industry partners.

Fig 4: Tanya Shields with a group of primary teachers, York, England

Dudley Shallcross, CEO, PSTT

The PSTT strives to facilitate the development and dissemination of excellence in primary science via ideas, resources or continuing professional development.

The strategy of the Primary Science Teaching Trust consists of three approaches:

1. supporting award-winning primary science teachers through their Primary Science Teacher College;
2. supporting groups of schools working together through a Cluster Programme;
3. supporting research and innovation through their Academic Collaborators.

Jane Turner, Founder and director, PSQM, University of Hertfordshire

PSQM is a teacher professional development framework that helps schools to achieve a quality mark. The programme enables science subject leaders to develop and strengthen their leadership practice, whilst increasing the profile and quality of science within their school. The process supports subject leaders to plan for improvement in science teaching and learning across the school and evaluate the impact of actions taken.

The programme is co-funded by the University of Hertfordshire and the PSTT. Schools pay a small contribution to go through the year-long process of gaining this quality mark.

5. RESPONSES TO KEY QUESTIONS

The questions that follow were asked of all the people I met on my trip. I have summarised their responses below.

A. What value is there in teaching children about science?

Everyone I met had a lot to say about this. Below are some quotes that exemplify the common themes in the answers.

> "We need to start teaching children as early as possible to understand nature. This needs to be done through play and fun, not in a burdensome way. 'If you don't know, you can't make informed decisions' – we rely on the next generation to understand how to protect our water, our climate, our world. People need to have knowledge in order to contribute meaningfully to society. Science is as important as literacy, maths and economics." Prof Wefer, Haus der wissenschaft

> "We need to foster curiosity. Science is such a big part of who we are and what we use. It is everywhere in our daily life. Children need an awareness of the nature of science – the methods and way of thinking that helps us explain our world." Tanja Klop, Science centre Delft

> "The ASPIRES project research [e] shows that by the age of 10 kids may not know what they want to do when they grow up, but they have already decided what they do not want to do. If they haven't been exposed to science by then they are not likely to see themselves in a science career in the future." Judith Bennett, University of York

> "While not all children will follow a career in science or related disciplines when they leave the school system, science literacy will influence their lives daily. For example, managing their health and understanding issues such as climate change. This means that science taught in primary schools is of vital importance to individuals and the nation's well-being." Dudley Shallcross, PSTT

B. In your opinion, what is the most useful tool or strategy for engaging children in science learning?

Again, there was a lot of overlap in the answers I received to this question, most agreed that science learning had to be:

- hands on
- fun
- linked to real life
- co-operative
- structured
- curiosity based
- started at a young age
- led by confident educators with quality resources.

Fig 5: Hands-on: 'milking' a cow in 'Switzerland' at the Klimahaus, Bremerhaven, Germany

C. What do you think are some of the greatest barriers to children engaging in science learning?

Most of the people I spoke to agree the main barrier is the teacher.

In primary schools the teachers are not trained in science, they often feel insecure and lack the materials to teach science lessons. Even if there is equipment it is frequently neglected or has missing parts as there is no ownership.

Teachers are under a lot of time pressure with new initiatives, student behaviour issues and lack of consistent policies.

Additionally, there is the gender issue: most primary teachers are women. They generally do not feel confident to teach technical subjects like science so there is no role-modelling for girls. This is a huge problem. If we want more science in schools (and we do!) we need to make it easy for teachers.

6. SCIENCE CENTRES AND MUSEUMS

Centres visited

1. Haus der wissenschaft (House of science). Bremen, Germany: Community venue, temporary exhibitions, meeting and lecture venue.

2. Klimahaus (Climate centre). Bremerhaven, Germany: Great concept following the 8th degree east longitudinal line. Nine locations were highlighted as visitors followed this line. At each station there were activities, information and a person or family to meet. Climate issues were highlighted in the personal stories. A lot of effort had been made to really experience each location (heat, humidity, sand, animals, etc).

3. Universum (Universe). Bremen, Germany: A large centre that has permanent exhibitions on technology, the body and nature plus an outdoor area with water and forces activities. There is a 30-minute science show twice a day. They also run special 'dinner in the dark' shows and provide free online worksheets for students.

4. Corpus (Body). Leiden, the Netherlands: A trip through the human body. Personal audio, small tour groups and impressive surrounds. Short video clips, smells and some 3D movies. The 55-minute journey was followed by interactive exhibits. The content was generally aimed at primary aged children.

5. Museon (Museum for Education). The Hague, the Netherlands: A huge facility that easily takes four or more hours to explore. Very high-quality exhibits. 18 rooms off the main hall each explore a different topic, these rooms can be closed for group lessons.

6. Science Centre Delft, the Netherlands: Part of the Technical University of Delft. The main purpose is to provide a gateway to the university, to showcase the cutting-edge research being conducted at the university and inspire future students to come and study there.

7. Ontdekfabriek (discovery factory). Eindhoven, the Netherlands: A massive makerspace. There is a strong story-line focus which is explained in an excellent 30-minute movie. Great hands-on, interactive things to do and build, like stop-motion movie drawings, green screen action scenes, plastic moulding of a boat hull, 3D printing etc. Huge factory feeling, all open space. A couple of smaller rooms for workshops (birthday parties etc). Plus, an outdoor space with lots of big 'toys'.

8. NEMO. Amsterdam, the Netherlands: Massive and very cool. Everybody in Holland seems to know about this place. The word NEMO means 'nobody' in Latin and the idea is that you enter as nobody and leave as somebody. Four levels with a different theme on each: phenomena, technical, elements and humans. Lots of interactive exhibits and very busy with school groups – mostly 11-year olds.

Fig 6: Dolly the sheep at the National Museum of Scotland, Edinburgh, Scotland

9. National Museum of Scotland, Edinburgh, Scotland: A vast museum over seven levels covering the history of Scotland, wonders of nature and diverse cultures. Significant science sections including machines, discoveries, innovation, animal world and planet earth. They have Dolly the sheep (taxidermied) on display.

10. National STEM learning centre, York, England: Impressive centre that runs 45,000 days of teacher PLD each year, reaching over 20,000 educators. Courses are delivered at the national STEM learning centre (residential), in regional centres and online, covering primary and secondary science, maths and digital technology, as well as school science technicians. The centre in York has an extensive library of resources – models, interactive exhibits and books – that can be accessed while attending a residential PLD course.

11. Wellcome collection, London, England: Variety of exhibits that change every six months or so. The Wellcome collection itself is a historic overview of Henry Wellcome who left a lot of money in his will that became the Wellcome Trust. There are medical articles and equipment that date back hundreds of years.

12. Science museum, London, England: This place is huge. I spent five hours here and still didn't see it all. Very distinct theme areas with the majority very 'museumy' and not overly interactive, a lot of reading and occasionally listening to video clips. The exhibits were very impressive though. The interactive areas like the 'Wonderlab' and 'Flight' had an admission fee whereas the main museum is free of charge.

Effective methods of engaging children

I spent a lot of time observing children who were visiting these science centres. My goal was to identify how engaged the children were in the experience. Some of the exhibits were very impressive but did not encourage children to stop and think about the science being conveyed.

Of all the centres I saw, one was outstanding in its ability to engage all ages of visitors. This was the Universum in Bremen. The key here was that nearly every exhibit required two or more people to complete a task collaboratively or competitively. This simple 'trick' meant that discussion inevitably ensued. Sometimes the discussions were heated arguments, but in every case, they involved participants trying to explain to each other the science that was involved. Absolutely genius!

Fig 7: High engagement at the Universum in Bremen, Germany

7. EXAMPLES OF GOOD PRACTISE

Curricula

All countries visited (Germany, the Netherlands, Scotland and England) have a highly structured primary science curriculum. Teachers know what content they need to teach and when. The inspectors (ERO equivalent) examine every aspect of the schools' performance including all curriculum areas thoroughly and regularly.

Most teachers in England strongly believe that it is a statutory requirement to deliver a minimum of two hours of science a week. I understand this is not actually a statutory requirement, just a strongly held belief!

Teachers

Teachers know what science they need to teach but the issue is with the way it is taught and the shift from science content knowledge to science skills. Content can, and often is, taught through books and worksheets with lots of online resources available in all countries visited. Some organisations are trying to incorporate videos and apps to make the content more interactive, but the main concern of leaders is the lack of hands-on science experiments.

In England the Ofsted framework for the 2019-2020 school year[f] has placed a greater emphasis on practical science. This statement carries a lot of weight and many primary principals I spoke to were looking at ways to increase funding in science this coming year to cater for this Ofsted focus.

"Science has clearly been downgraded in some primary schools since the scrapping of the key stage 2 test. This is likely to have a serious impact on the depth and breadth of science understanding and knowledge that pupils take with them into secondary school, which may in turn stifle pupils' later curiosity and interest in the sciences. School leaders need to ensure that teachers have deep subject knowledge and to consider what curriculum design really involves in science. We will carry out further investigations on the primary science curriculum later this year." [g] Ofsted quote from 11 Feb 2019.

Resources

Teachers I spoke to agreed that resources were generally not an issue, there was plenty of science equipment available in their school. These teachers were all at the Primary Science Teacher Conference, so one can infer they value science, and this may not be a representative sample. On average their schools have an annual science equipment and consumable budget of £2,000 (NZ$4,000). The amount varies depending on the size of the school, this figure is for a school of approximately 200 pupils. This is allocated by the school's board of governors out of the pool of school funds.

Most schools appear to have a dedicated science lead teacher who is not trained or qualified in science but has shown an interest in the subject. These lead teachers usually have full control over how the science budget is spent.

The Edina Trust provides science grants for primary schools that lack resources. They ask schools to complete a simple questionnaire about the science resources currently available at their schools. Results of this survey showed the majority of the

473 respondents agreed that the lack of quality science resources was restricting the type and amount of science taught (see Appendix 2).

Professional development

The UK has an internationally renowned science education support infrastructure, with the National Science Learning Network at its heart. The Network has been providing subject-specific support for 10 years. A recent independent impact study of their work has shown improved teaching and learning, and increased uptake and achievement in science. [h]

Fig 8: Primary teacher science professional development at the National STEM Learning Centre, York, England

The aspect that delivered the greatest impact was sustained engagement – four or more courses attended over two or more years has a significantly higher impact than one off courses or short engagement.

Assessment

All countries I visited have a desire to shift from assessing science knowledge to science skills ('thinking scientifically') which are inherently harder to assess. This aligns with an increased focus on teaching science thinking skills rather than pure content knowledge. The IPC uses a self-assessment grid for students and detailed guidance for teachers that is skills-based.

For many years in the UK, Science Standard Assessment Tests (SAT) were administered and reported on at year six which is the end of Key Stage 2. These disappeared in 2012 which is widely regarded as a good thing but there is a strong culture of (over)assessment in the UK, so science assessment resources are in demand. There are many private companies selling online science assessment tools that are aligned to the primary curriculum Key Stages. The content being assessed at Key Stage 2 in the UK (year 6) is on a par with NZ students learn in year 9 & 10 (see Appendix 1).

The best example of science assessment I saw was the Teacher Assessment in Primary Science (TAPS[i]). They have developed a pyramid model where assessment information flows from classroom practice to whole school reporting. The TAPS pyramid provides a framework to support science subject leaders in identifying strengths and areas for development in school assessment systems. The interactive tool is user friendly, skills based and very powerful. It also appears very popular: the

TAPS website has 169 files that have been downloaded 118,000 times since its launch in 2017.

Incentive programmes

Primary Science Quality Mark (PSQM[j]) is a teacher professional development programme that helps schools to achieve a quality mark, whether science within the school has been a low profile for a while or the school wants to improve the provision further. The programme provides a framework and mentors that enable science subject leaders to develop and strengthen their leadership practice, whilst increasing the profile and quality of science within their school. The process supports subject leaders to plan for improvement in science teaching and learning across the school and evaluate the impact of actions taken.

Over 3,000 schools in the UK have taken part in this programme and have seen a marked impact on the leadership of science and on the breadth of learning and teaching experiences within and beyond the classroom. There was also evidence of changes emerging that would ensure the impact of the PSQM would be sustained beyond the programme year through planning and wider networking.

Evaluating impact

In the UK I saw evidence of comprehensive impact studies and evaluations of primary science. These studies are funded by a variety of investors in the field to ensure their money is being well spent.

The National Science Learning Network in the UK published an impact report in 2015 after ten years of operation. The report is a collation of 14 research projects conducted by a variety of independent institutions over a five-year period.[h]

The Wellcome Trust, who generously fund primary science education in the UK, commissioned their own research to ensure their investment is returning significant impact.[k] Their 'State of the nation' report of UK primary science education, conducted by CFE research, was published in September 2017.

Funding

All countries visited see the importance of STEM subjects as a foundation for innovation for the future. All have clear goals aimed at addressing concerns over low numbers of young people opting to study STEM subjects in the latter stages of their education and move into STEM-related careers. As a result, governments invest heavily in primary science education, over and above general school funding. This money is clearly targeted at improving student skills rather than knowledge and at raising teacher confidence, expertise and leadership.

Governments – national, state and local body – are more likely to invest in primary science teacher training as opposed to school science resources. This is largely because schools allocate significant science budgets to purchase resources (see 'resources' section above).

In the UK

The Wellcome Trust, the Primary Science Teaching Trust, the Edina Trust, universities and the Royal Society, all contribute significant funds to support schools with science resources and professional development.

An example of the funding received by the Science Learning Centre Network in the UK is £4.5M per annum in grants, 39% of their annual turnover [l]. There is a huge financial incentive for schools to send teachers to this centre: Schools pay for teachers to attend the science learning centre PLD courses however, at the completion of the course evaluation they receive a full refund plus payment of associated costs like relief teacher and travel, so that the school is financially better off if they send a teacher to a course here.

The PSTT contributed £1.3M to primary science initiatives in the UK in the last financial year [m].

The Edina Trust's main charitable purpose is to support science education at primary school level. They provide non-competitive, easy-to-access £600 science grants, for primary schools the UK. Last year they gave away over £500,000.

In Scotland

Scotland is comparable to New Zealand in population but is only 30% of New Zealand's land area. The Scottish Schools Education Research Centre (SSERC) focus solely on Science professional development. 73% of their income is from central and local government [n].

<u>SSERC's funders:</u>

Scottish Government grants	£	855,000	41% of total
Local Authority contributions	£	668,000	32% "
Income from STEM Learning	£	297,000	14% "
Income from PSTT	£	121,000	6% "
Other income	£	164,000	8% "
Total income	£	2,105,000	

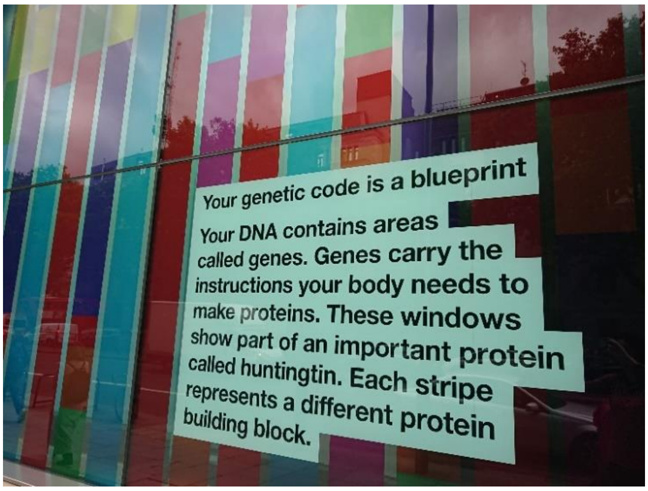

Fig 9 & 10: the Wellcome Trust head office, London, England

8. CONCLUSION AND RECOMMENDATIONS

Conclusions:

- Students are most engaged in science learning when conducting practical collaborative tasks.
- Comprehensive, subject-specific support is making a lasting positive impact on primary science teaching and learning in the UK.
- Professional development focusses on increasing student engagement through interactive, skills-based learning experiences.
- Schools are incentivised to upskill teachers financially and are rewarded for sustained professional development through a desirable award system.
- The most useful assessment tools are responsive, interactive and student focussed. They form an integral part of teaching and learning, rather than a stand-alone pen and paper test.
- Countries are investing in primary science because they can see the need for a STEM-ready workforce in the future. The funding model is government driven with private trusts and businesses in support.
- Robust evaluation studies monitor impact and ensure investments are wisely allocated.

Recommendations for New Zealand

New Zealand primary aged children are largely missing out on quality science education which is jeopardising their future career choices. Studies in the UK show that children must be exposed to science by the age of 10 to envisage themselves in a science career in the future. Engagement in primary science will increase the likelihood of students choosing a science career pathway post formal schooling.

In order to improve the quality and quantity of science in our primary schools, I recommend we establish a comprehensive, well-funded science support structure for primary and intermediate schools that includes:

- sustained, high quality teacher professional development
- science resources that facilitate practical, collaborative learning experiences
- science assessment-for-learning tools
- incentives for school leaders
- evaluation of impact conducted by independent bodies

Fig 11: Quality, sustained teacher PLD at the national STEM learning centre, York, England

9. DISSEMINATION

Since returning from my trip I have a broader view of what we as a country need to do to improve science learning in our primary and intermediate schools. I strongly recommend New Zealand establish a comprehensive, well-funded science support structure for primary and intermediate schools. I have shared my findings and recommendations in this report as follows:

Meetings with Members of Parliament

- Chris Hipkins – Minister of Education
- Nikki Kaye – National Party spokesperson for education
- Simon Bridges – leader of the National Party and Tauranga Member of Parliament
- Todd Muller – National Party Spokesperson for Agriculture and Bay of Plenty Member of Parliament
- Jan Tinetti - Member of the Education and Workforce select committee and Labour party list MP, Tauranga

Meetings with Educational leaders

- Mark Grams, Lead advisor, curriculum design and assessment, Ministry of Education
- Stuart McNaughton, Chief Education Science Advisor to the Prime Minister's Chief Science Advisor
- Dale Anderson, Programme Director Graduate Diploma of Teaching, Faculty of Education, Victoria University of Wellington
- Graham Aitken, Director of educational initiatives, office of the Vice Chancellor, University of Auckland
- Nina Hood, CEO, The Education Hub
- Ezra Schuster, Bay of Plenty Regional Director, ministry of Education

Meetings with Science leaders

- Gary Evans, Chief Science Advisor, Ministry of Business Innovation and Employment and Advisor to the Prime Minister's Chief Science Advisor
- Michael Bunce, Chief Scientist, Environmental Protection Authority and Advisor to the Prime Minister's Chief Science Advisor
- Susie Meade, Principal Advisor, Office of the Prime Minister's Chief Science Advisor
- All communications Managers of the 11 National Science Challenges

As CEO of the House of Science, a national organisation that produces and distributes science equipment for NZ primary schools, I am in a privileged position to influence the science learning in a growing number of schools.

I offered to write an article for the NZ Science teacher magazine summarising my findings. This magazine is the main publication of the NZ association of science educators, published annually. It is circulated to most NZ schools. Unfortunately, the 2019 magazine did not eventuate.

Finally, the full report of my trip is available to download from the House of Science website, used by over 1,500 people a month. https://houseofscience.nz/about/

10. ACKNOWLEDGEMENTS

Thank you to the following people who generously gave of their time and provided me with an insight into their world.

Professor Gerold Wefer, Director, House of Science Bremen, Germany (Haus der wissenschaft).

Professor Michael Schultz and Dr Martina Patzold, Director and school educator, Marum Institute, University of Bremen, Germany.

Friso Visser, Deputy Director, MUSEON The Hague, Netherlands

Dr Roel & Marijke Vijn, retired teachers and hosts, 's Gravenzande, The Netherlands

Linda Vijn, curriculum leader and teacher of year 3, International School Delft (primary), Delft, the Netherlands.

Tanja Klop, Education team leader, Science Centre Delft, Delft, The Netherlands.

Hugo Vrijdag, Founder of De Ontdekfabriek (the discovery factory), Eindhoven, The Netherlands.

Mascha Jansen, mother, farmer and hostess, Zelhem, The Netherlands

Ilona Gerritsen, mother, event manager and hostess, Bloemendaal, The Netherlands

Alistair MacGregor, CEO of SSERC, Edinburgh, Scotland.

Professor Judith Bennet, Salters' Professor of Science Education at the University of York, York, UK

Joy Parvin, University of York, Director of the Centre for Industry Education Collaboration, York, UK

Tanya Shields, Primary science team leader at STEM learning centre. University of York, York, UK.

Louise Stubberfield, Programme manager – education Wellcome Trust, London, England

Professor Dudley Shallcross, CEO Primary Science Teaching Trust, University of Bristol, England

Associate Professor Jane Turner, Director of Primary Science quality Mark (PSQM) at the University of Hertfordshire, Hatfield, England.

Jane Dowden Director of education at the British Science Association (BSA) London, England

Samantha Moore, Trust Administrator, Edina Trust, Witney, UK

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12. APPENDICES

1. Question sample from UK SAT test, Key Stage 2 (Year 6)

i) Sort the five things in the box below into **living** and **non-living** things.
One has been done for you.

bacteria glass dish mould agar (jelly) human

Living things	Non-living things
bacteria	

Most New Zealand students will learn this in Year 9

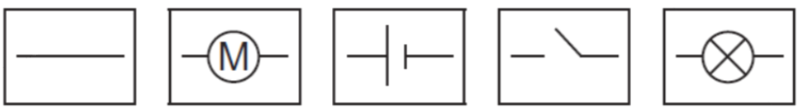
i) Growing is a life process.

Name **ONE** other life process.

Draw **FOUR** lines to match the electrical components to their symbols.

Electrical component: bulb | wire | cell | switch

Symbol



Most New Zealand students will learn this in Year 10

2. The Edina Trust science resource grant questionnaire

Results for September 2018 to June 2019

The ranking is 1 = strongly disagree, 5 = strongly agree. This includes the responses from 473 schools.

1.The lack of quality science resources in school inhibits/dictates the **type** of science lessons we can deliver

Score: 4.27 (Agree)

2.The lack of quality science resources in school inhibits/dictates the **number** of science lessons we can deliver

Score: 3.87 (Agree)

3.The science resources we have in school **restrict the number of pupils** that can actively take part in practical science. This means that science is often 'demonstrated' by teachers rather than carried out by pupils

Score: 4.15 (Agree)

4.The opportunities and experiences we currently offer for science visits/science visitors are limited

Score: 4.11 (Agree)

5.Our current science **resources do not enthuse** and encourage our pupils to have a lasting interest in science

Score: 3.9 (Agree)